

## Chapter 7—Personal Protective Equipment

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### 10.47 Compliance with regulations and standards

Employers and employees shall adhere to the Saudi Labor Law, Modon: Safety and occupational health guidelines, SASO-3001 Occupational safety and health procedures in the work environment - safety helmet, SASO Guide on occupational safety and health – Safety Shoes, and in SASO-2992 Occupational safety and health procedures in the work environment - safety shoes, SASO Technical Regulation for Personal Protective Equipment and Clothing , SASO 1938 : Personal Eye Protection – Mesh Eya and Face Protectors, SASO 174, SASO 207, SASO 208, SASO 379, SASO 1731, SASO Guide on occupational safety and health – Hand Protection , SASO-3000 Occupational safety and health procedures in the work environment - protect hands, NIOSH, ISO 4850, ANSI/ISEA Z87.1–2010, ANSI Z87.1–2003, ANSI Z87.1–1989 (R–1998), ANSI/Compressed Gas Association Commodity Specification for Air, G–7.1–1989, ANSI Z89.1–2009, ANSI Z89.1–2003, ANSI Z89.1–1997, ANSI Z41–1999, ANSI Z41–1991 , ASTM F–2412–2005, ASTM D120–09, ASTM D178–01(2010), ASTM D1048–12, ASTM D1049–98(2010), ASTM D1050–05(2011), ASTM D1051–08, ASTM F1236–96 (2012), ASTM F819–10, GSO ISO 20344, GSO ISO20346, GSO ISO347, ISO21420, ISO13997, ISO15388, ISO374, ISO21420,

ISO11393, SASO ISO 11612, ISO14116, ISO710, ISO3873 ISO20471, ISO16321, ISO19734, ,  
ISO4007,ISO12312, ISO18527, ISO12401,ISO20471,ISO14116, ISO150225 ISO11611, IEC6182,  
IEC61482 EN166, EN149, EN13034, EN13758, ISO11393, ISO13998, ISO27065 , EN352, ISO4869,  
EN60903, EN60903, ISO21420, IEC61482, ISO15797, ISO20471: AS/NFS1337,1, Directive  
89/686/EEC.And All other occupational safety and health regulations issued in the Kingdom that stipulate  
the need to use personal protective equipment.

## 10.48 General Requirements

### (a) Application.

- (1) Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

### (b) Employee-owned equipment.

- (1) Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.
- (2) A worker shall use and preserve the personal protective equipment designated for each process and shall carry out the instructions established to protect his health against injuries and diseases. He shall refrain from any action or omission that may lead to failure to implement the instructions, misuse, or impair the devices provided to protect the workplace as well as the health and safety of fellow workers, as per the Saudi Labor Law, article 124.

### (c) Design.

All personal protective equipment shall be of safe design and construction for the work to be performed.

### (d) Hazard assessment and equipment selection

- (1) The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:
  - (i) Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment.
  - (ii) Communicate selection decisions to each affected employee.

- (iii) Select PPE that properly fits each affected employee.
- (2) The employer shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment.
- (3) An employer shall inform the worker, prior to engaging in the work, of the hazards of his job and shall require him to use the prescribed protective equipment. The employer shall supply the workers with the appropriate personal gear and train them on their use, as per the Saudi Labor Law, article 123.

(e) Defective and damaged equipment.

Defective or damaged personal protective equipment shall not be used.

(f) Training

- (1) The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:
  - (i) When PPE is necessary.
  - (ii) What PPE is necessary.
  - (iii) How to properly don, doff, adjust, and wear PPE.
  - (iv) The limitations of the PPE; and,
  - (v) The proper care, maintenance, useful life and disposal of the PPE.
- (2) Each affected employee shall demonstrate an understanding of the training specified in paragraph (f)(1) of this section, and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.
- (3) When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph (f)(2) of this section, the employer shall retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:
  - (i) Changes in the workplace render previous training obsolete; or
  - (ii) Changes in the types of PPE to be used render previous training obsolete; or
  - (iii) Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

(g) Payment for protective equipment.

- (1) Except as provided by paragraphs (g)(2) through (g)(6) of this section, the protective equipment, including personal protective equipment (PPE), used to comply with this part, shall be provided by the employer at no cost to employees.
- (2) The employer is not required to pay for non-specialty safety-toe protective footwear (including steel-toe shoes or steel-toe boots) and non-specialty prescription safety eyewear, provided that the employer permits such items to be worn off the jobsite.
- (3) When the employer provides metatarsal guards and allows the employee, at his or her request, to use shoes or boots with built-in metatarsal protection, the employer is not required to reimburse the employee for the shoes or boots.
- (4) The employer is not required to pay for:
  - (i) Everyday clothing, such as long-sleeve shirts, long pants, street shoes, and normal work boots; or
  - (ii) Ordinary clothing, skin creams, or other items, used solely for protection from weather, such as winter coats, jackets, gloves, parkas, rubber boots, hats, raincoats, ordinary sunglasses, and sunscreen.
- (5) The employer must pay for replacement PPE, except when the employee has lost or intentionally damaged the PPE.
- (6) Where an employee provides adequate protective equipment, he or she owns pursuant to paragraph (b) of this section, the employer may allow the employee to use it and is not required to reimburse the employee for that equipment. The employer shall not require an employee to provide or pay for his or her own PPE, unless the PPE is excepted by paragraphs (g)(2) through (g)(5) of this section.
- (7) The employer may not charge the workers or deduct from their wages any amounts for the provision of such protection, as per the Saudi Labor Law, article 122.

## 10.49 Eye and Face Protection

(a) General Requirements:

- (1) Appropriate eye protection shall be worn when performing the following tasks:
  - (i) When using any type of adhesives and/or solvent solutions

- (ii) When grinding and leveling concrete surfaces
  - (iii) When working in environments containing gases
  - (iv) When handling chemical materials
  - (v) When performing any operations that generate dust
- (2) The employer shall provide means in the equipment to prevent bad vision and protect from hazing (SASO: Technical Regulation for Personal Protective Equipment and Clothing – Personal Protective Equipment for Face and Eyes)
  - (3) The employer shall ensure that each affected employee uses eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g. clip-on or slide-on side shields) meeting the pertinent requirements of this section are acceptable.
  - (4) The employer shall ensure that each affected employee who wears prescription lenses while engaged in operations that involve eye hazards wears eye protection that incorporates the prescription in its design, or wears eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.
  - (5) Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer.
  - (6) The employer shall ensure that each affected employee uses equipment with filter lenses that have a shade number appropriate for the work being performed for protection from injurious light radiation. The following is a listing of appropriate shade numbers for various operations.

*Table 1* Filter Lenses for Protection Against Radiant Energy

Operations	Electrode size 1/32 in	Arc current	Minimum * protective shade
Shielded metal arc welding	Less than 3	Less than 60	7
	3–5	60–160	8
	5–8	160–250	10
	More than 8	250–550	11
Gas metal arc welding and flux cored arc welding		Less than 60	7
		60–160	10
		160–250	10
		250–500	10
Gas Tungsten arc welding		Less than 50	8
		50–150	8
		150–500	10

Air carbon	(Light)	Less than 500	10
Arc cutting	(Heavy)	500–1000	11
Plasma arc welding		Less than 20	6
		20–100	8
		100–400	10
		400–800	11
Plasma arc cutting	(light) **	Less than 300	8
	(medium) **	300–400	9
	(heavy) **	400–800	10
Torch brazing			3
Torch soldering			2
Carbon arc welding			14

Table 2 Filter Lenses for Protection Against Radiant Energy

Operations	Plate Thickness- inches	Plate Thickness- mm	Minimum* Protective Shade
Gas Welding:			
Light	Under 1/8	Under 3.2	4
Medium	1/8 to 1/2	3.2 to 12.7	5
Heavy	Over 1/2	Over 12.7	6
Oxygen cutting:			
Light	Under 1	Under 25	3
Medium	1 to 6	25 to 150	4
Heavy	Over 6	Over 150	5

\* As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

\*\* These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.

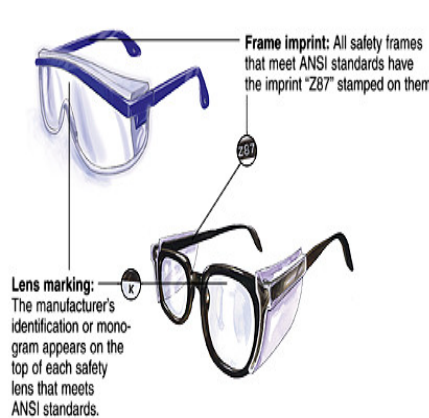
More details can be found in SASO-EN-1938: Personal Eye Protection – Mesh Eye and Face Protectors , and in SASO Technical Regulation for Personal Protective Equipment and Clothing – Personal Protective Equipment for Face and Eyes, ANSI/ISEA Z87.1–2010, ANSI Z87.1–2003, ANSI Z87.1–1989 (R–1998), Directive 89/686/EEC and AS/NFS1337.1.

(b) Criteria for protective eye and face protection:

- (1) Protective eye and face protection devices must comply with the relevant consensus standards from the following:

- (i) SASO Technical Regulation for Personal Protective Equipment and Clothing
  - (ii) SASO 1938: Personal Eye Protection – Mesh Eye and Face Protectors; or
  - (iii) SASO 4850 (ISO 4850), SASO 174, SASO 207, SASO 208, SASO 379, SASO 1731, or equivalent
  - (iv) ANSI/ISEA Z87.1–2010, Occupational and Educational Personal Eye and Face Protection Devices
  - (v) ANSI Z87.1–2003, Occupational and Educational Personal Eye and Face Protection Devices; or
  - (vi) ANSI Z87.1–1989 (R–1998), Practice for Occupational and Educational Eye and Face Protection
- (2) Protective eye and face protection devices that the employer demonstrates are at least as effective as protective eye and face protection devices that are constructed in accordance with one of the above consensus standards will be deemed to be in compliance with the requirements of this section.
- (3) Marking: The user must require the marking on the product at the time of purchase and check it on receipt according to the standards used, as illustrated in the examples below.

Figure 1 Marking on lenses and frame in accordance with ANSI 87



Frame imprint: All safety frames that meet ANSI standards have the imprint "Z87" stamped on them.

Lens marking: The manufacturer's identification or monogram appears on the top of each safety lens that meets ANSI standards.

Type of Mark	Description	Marking for completed Device (no replaceable parts)	Order Information
Impact	Impact Rated Plano Impact Rated Rx	Z87+ Z87-2+	
Non-Impact	LG113	Z87 Z87-2	
Lens Type	Clear	None	493.8
	Welding	W and Shade Number	Shades range from 1.3 to 14; the higher the shade number, the darker the lens.
	UV Filter	U and Scale Number	Scale ranges from 2 to 6, with lenses marked as "U6" providing the highest protection from far and near UV.
	Visible Light Filter	L and Scale Number	Scale ranges from 1.3 to 10, with lower numbers providing greater light transmittance.
	IR Filter	R and Scale Number	Scale ranges from 1.3 to 10.
	Variable Tint	V	
Use	Special Purpose	S	
	Splash/Droplet	D3	
	Dust Fine Dust	D4 D5	

Figure 2 Marking on lenses and frame in accordance with EN166

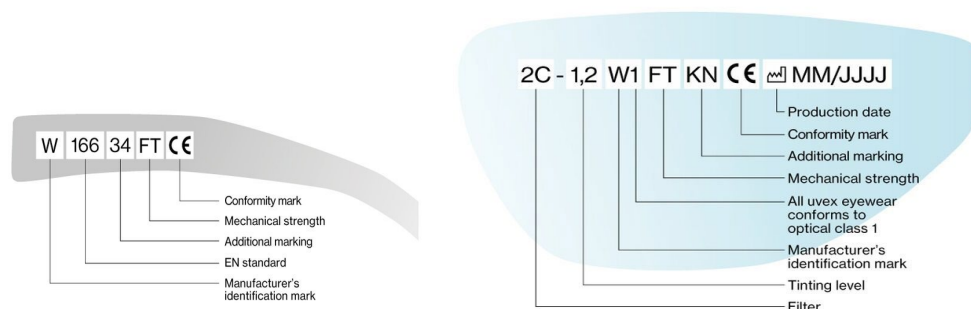
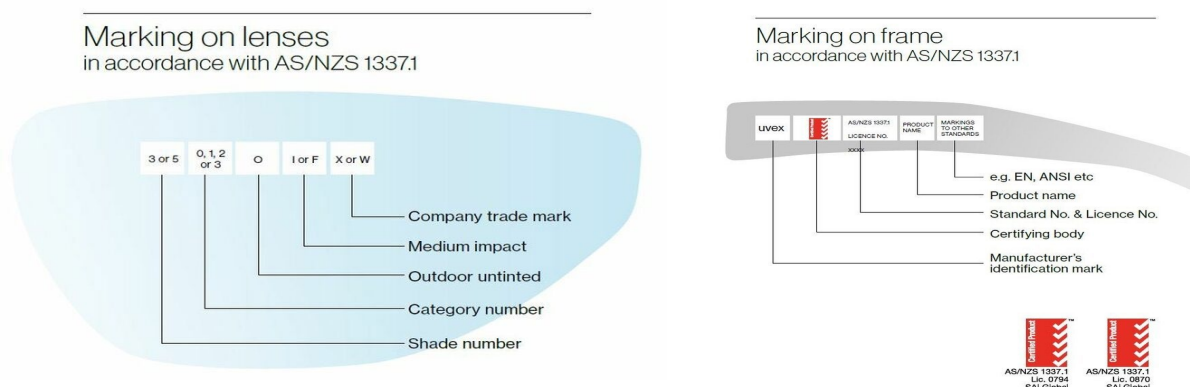




Figure 3 Marking on frame in accordance with AS/NZS 1337.2



## 10.50 Respiratory Protection

### (a) Permissible practice.

- (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapours, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.
- (2) A respirator shall be provided to each employee when such equipment is necessary to protect the health of such employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program, which shall include the requirements outlined in paragraph (c) of this section. The program shall cover each employee required by this section to use a respirator.

### (b) **Definitions.** The following definitions are important terms used in the respiratory protection standard in this section.

- (1) **Air-purifying respirator** means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.
- (2) **Assigned protection factor (APF)** means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer

implements a continuing, effective respiratory protection program as specified by this section.

- (3) **Atmosphere-supplying respirator** means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.
- (4) **Canister or cartridge** means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.
- (5) **Demand respirator** means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.
- (6) **Emergency situation** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.
- (7) **Employee exposure** means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.
- (8) **End-of-service-life indicator (ESLI)** means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.
- (9) **Escape-only respirator** means a respirator intended to be used only for emergency exit.
- (10) **Filter or air purifying element** means a component used in respirators to remove solid or liquid aerosols from the inspired air.
- (11) **Filtering facepiece** (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.
- (12) **Fit factor** means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.
- (13) **Fit test** means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)
- (14) **Helmet** means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

- (15) **High efficiency particulate air (HEPA) filter** means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter.
- (16) **Hood** means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.
- (17) **Immediately dangerous to life or health (IDLH)** means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.
- (18) **Interior structural firefighting** means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage.
- (19) **Loose-fitting facepiece** means a respiratory inlet covering that is designed to form a partial seal with the face.
- (20) **Maximum use concentration (MUC)** means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the required permissible exposure limit, short-term exposure limit, or ceiling limit. When no exposure limit is available for a hazardous substance, an employer must determine an MUC on the basis of relevant available information and informed professional judgment.
- (21) **Negative pressure respirator (tight fitting)** means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.
- (22) **Oxygen deficient atmosphere** means an atmosphere with an oxygen content below 19.5% by volume.
- (23) **Physician or other licensed health care professional (PLHCP)** means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.
- (24) **Positive pressure respirator** means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

- (25) **Powered air-purifying respirator (PAPR)** means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.
- (26) **Pressure demand respirator** means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.
- (27) **Qualitative fit test (QLFT)** means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.
- (28) **Quantitative fit test (QNFT)** means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
- (29) **Respiratory inlet covering** means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.
- (30) **Self-contained breathing apparatus (SCBA)** means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.
- (31) **Service life** means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.
- (32) **Supplied-air respirator (SAR) or airline respirator** means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.
- (33) **Tight-fitting facepiece** means a respiratory inlet covering that forms a complete seal with the face.
- (34) **User seal check** means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

(c) Respiratory protection program:

This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator.

- (1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and

implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

- (i) Procedures for selecting respirators for use in the workplace;
  - (ii) Medical evaluations of employees required to use respirators;
  - (iii) Fit testing procedures for tight-fitting respirators;
  - (iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;
  - (v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;
  - (vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;
  - (vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;
  - (viii) Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and
  - (ix) Procedures for regularly evaluating the effectiveness of the program.
- (2) Where respirator use is not required:
- (i) An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the needed information, and
  - (ii) In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

- (3) The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.
- (4) The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

(d) Selection of respirators.

This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH (immediately dangerous to life and health) atmospheres and limits the selection and use of air-purifying respirators.

(1) General requirements.

- (i) The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.
- (ii) The employer shall select a NIOSH-certified respirator, ECC certified respirator, AS Certified respirator or equivalent. The respirator shall be used in compliance with the conditions of its certification.
- (iii) The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH (immediately dangerous to life and health).
- (iv) Employer shall ensure that affected employees wear appropriate respiratory devices when engaging in industrial activities such as:
  - (A) When using any type of adhesives and/or solvent solutions
  - (B) When grinding and levelling concrete surfaces
  - (C) When working in environments containing gases
  - (D) When handling chemical materials
  - (E) When performing any operations that generate dust

- (F) When “MSDS” safety data sheet requirements “section 8”
- (v) The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
- (2) Respirators for IDLH atmospheres.
- (i) The employer shall provide the following respirators for employee use in IDLH atmospheres:
- (A) A full facepiece pressure demand SCBA certified by NIOSH or other authorities like EC for a minimum service life of thirty minutes, or
- (B) A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.
- (ii) Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified or other authorities like EC for escape from the atmosphere in which they will be used.
- (iii) All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table 4 of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.
- (3) Respirators for atmospheres that are not IDLH.
- (i) The employer shall provide a respirator that is adequate to protect the health of the employee.
- (A) **Assigned Protection Factors (APFs).** Employers must use the assigned protection factors listed in Table 3 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

Table 3—Assigned Protection Factors<sup>5</sup>

Type of respirator <sup>12</sup>	Quarter mask	Half mask	Full facepiece	Helmet/hood	Loose-fitting facepiece

1.Air-Purifying Respirator	5	<sup>3</sup> 10	50		
2.Powered Air-Purifying Respirator (PAPR)		50	1,000	<sup>4</sup> 25/1,000	25
3.Supplied-Air Respirator (SAR) or Airline Respirator					
Demand mode		10	50		
Continuous flow mode		50	1,000	<sup>4</sup> 25/1,000	25
Pressure-demand or other positive-pressure mode		50	1,000		
4.Self-Contained Breathing Apparatus (SCBA)					
Demand mode		10	50	50	
Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)			10,000	10,000	

Notes:

<sup>1</sup> Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

<sup>2</sup> The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this chapter, including training, fit testing, maintenance, and use requirements.

<sup>3</sup> This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

<sup>4</sup> The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators and receive an APF of 25.



<sup>5</sup> These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by Chapter: Toxic and Hazardous Substances, employers must refer to the appropriate substance-specific standards in that chapter. Escape respirators for other IDLH atmospheres are specified by this chapter in (d)(2)(ii).

(B) Maximum Use Concentration (MUC).

- (1) The employer must select a respirator for employee use that maintains the employee's exposure to the hazardous substance, when measured outside the respirator, at or below the MUC.
- (2) Employers must not apply MUCs to conditions that are immediately dangerous to life or health (IDLH); instead, they must use respirators listed for IDLH conditions in paragraph (d)(2) of this standard.
- (3) When the calculated MUC exceeds the IDLH level for a hazardous substance, or the performance limits of the cartridge or canister, then employers must set the maximum MUC at that lower limit.

(ii) The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

(iii) For protection against gases and vapors, the employer shall provide:

(A) An atmosphere-supplying respirator, or

(B) An air-purifying respirator, provided that:

- (1) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH or other authorities like EC for the contaminant; or
- (2) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data.

(iv) For protection against particulates, the employer shall provide:

(A) An atmosphere-supplying respirator; or

- (B) An air-purifying respirator equipped with a filter certified by NIOSH or other equivalent authorities (such as EC) as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH; or other equivalent authorities (such as EC)
- (C) For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH or other equivalent authorities (such as EC).

Table-4

Altitude (ft.)	Oxygen deficient Atmospheres (%O <sub>2</sub> ) for which the employer may rely on atmosphere-supplying respirators
Less than 3,001	16.0-19.5
3,001-4,000	16.4-19.5
4,001-5,000	17.1-19.5
5,001-6,000	17.8-19.5
6,001-7,000	18.5-19.5
7,001-8,000 <sup>1</sup>	19.3-19.5

<sup>1</sup> Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000

feet.

- (e) **Medical evaluation.** Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.
  - (1) **General.** The employer shall provide a medical evaluation to determine the employee's ability to use a respirator before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.
  - (2) Medical evaluation procedures.

- (i) The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.
  - (ii) The medical evaluation shall obtain the information requested by the medical questionnaire.
- (3) Follow-up medical examination.
  - (i) The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions in the medical questionnaire or whose initial medical examination demonstrates the need for a follow-up medical examination.
  - (ii) The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.
- (4) Administration of the medical questionnaire and examinations.
  - (i) The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.
  - (ii) The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.
- (5) Supplemental information for the PLHCP.
  - (i) The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:
    - (A) The type and weight of the respirator to be used by the employee;
    - (B) The duration and frequency of respirator use (including use for rescue and escape);
    - (C) The expected physical work effort;
    - (D) Additional protective clothing and equipment to be worn; and
    - (E) Temperature and humidity extremes that may be encountered.

- (ii) Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.
- (iii) The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

*Note to paragraph (e)(5)(iii):*

*When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP.*

- (6) **Medical determination.** In determining the employee's ability to use a respirator, the employer shall:
  - (i) Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:
    - (A) Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;
    - (B) The need, if any, for follow-up medical evaluations; and
    - (C) A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.
  - (ii) If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.
- (7) **Additional medical evaluations.** At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:
  - (i) An employee reports medical signs or symptoms that are related to ability to use a respirator;

- (ii) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated.
  - (iii) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or
  - (iv) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.
- (f) **Fit testing.** This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed the procedures for conducting them, and how the results of the fit tests must be used.
- (1) The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.
  - (2) The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.
  - (3) The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.
  - (4) If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.
  - (5) The fit test shall be administered using a QLFT or QNFT protocol.
  - (6) QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

- (7) If the fit factor, as determined through a QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.
- (8) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.
  - (i) Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.
  - (ii) Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.
  - (iii) Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.
- (g) **Use of respirators.** This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.
  - (1) Facepiece seal protection.
    - (i) The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

- (A) Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
    - (B) Any condition that interferes with the face-to-facepiece seal or valve function.
  - (ii) If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.
  - (iii) For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator, this can be done through the procedures recommended by the respirator manufacturer that the employer demonstrates are effective.
- (2) Continuing respirator effectiveness.
- (i) Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.
  - (ii) The employer shall ensure that employees leave the respirator use area:
    - (A) To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or
    - (B) If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or
    - (C) To replace the respirator or the filter, cartridge, or canister elements.
  - (iii) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.
- (3) Procedures for IDLH atmospheres. For all IDLH atmospheres, the employer shall ensure that:
- (i) One employee or, when needed, more than one employee is located outside the IDLH atmosphere;
  - (ii) Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;

- (iii) The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;
- (iv) The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;
- (v) The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;
- (vi) Employee(s) located outside the IDLH atmospheres are equipped with:
  - (A) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
  - (B) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
  - (C) Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).
- (4) Procedures for interior structural firefighting. In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:
  - (i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;
  - (ii) At least two employees are located outside the IDLH atmosphere; and
  - (iii) All employees engaged in interior structural firefighting use SCBAs.

*Note 1 to paragraph (g): One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.*

*Note 2 to paragraph (g): Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.*

- (h) Maintenance and care of respirators: This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.
  - (1) Cleaning and disinfecting. The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:



- (i) Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
  - (ii) Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;
  - (iii) Respirators maintained for emergency use shall be cleaned and disinfected after each use; and
  - (iv) Respirators used in fit testing and training shall be cleaned and disinfected after each use.
- (2) Storage. The employer shall ensure that respirators are stored as follows:
  - (i) All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.
  - (ii) In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:
    - (A) Kept accessible to the work area;
    - (B) Stored in compartments or in covers that are clearly marked as containing emergency respirators; and
    - (C) Stored in accordance with any applicable manufacturer instructions.
- (3) Inspection.
  - (i) The employer shall ensure that respirators are inspected as follows:
    - (A) All respirators used in routine situations shall be inspected before each use and during cleaning;
    - (B) All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and
    - (C) Emergency escape-only respirators shall be inspected before being carried into the workplace for use.
  - (ii) The employer shall ensure that respirator inspections include the following:

- (A) A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and
  - (B) A check of elastomeric parts for pliability and signs of deterioration.
- (iii) In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.
- (iv) For respirators maintained for emergency use, the employer shall:
  - (A) Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and
  - (B) Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.
- (4) *Repairs.* The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.
- (i) Breathing air quality and use. This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

- (1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:
- (2) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

- (A) Oxygen content (v/v) of 19.5–23.5%;
  - (B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;
  - (C) Carbon monoxide (CO) content of 10 ppm or less;
  - (D) Carbon dioxide content of 1,000 ppm or less; and
  - (E) Lack of noticeable odor.
- (3) The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.
  - (4) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.
  - (5) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:
    - (i) Cylinders are tested and maintained;
    - (ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and
    - (iii) The moisture content in the cylinder does not exceed a dew point of –50 °F (–45.6 °C) at 1 atmosphere pressure.
  - (6) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:
    - (i) Prevent entry of contaminated air into the air-supply system;
    - (ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 °C) below the ambient temperature;

- (iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.
  - (iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.
- (7) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.
- (8) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.
- (9) The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.
- (10) The employer shall use only the respirator manufacturer's NIOSH-approved breathing-gas containers, marked and maintained in accordance with the Quality Assurance provisions of the NIOSH approval for the SCBA as issued in accordance with the NIOSH respirator-certification standard.
- (j) Identification of filters, cartridges, and canisters. The employer shall ensure that all filters, cartridges, and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.
- (k) Training and information. This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary.
- (1) The employer shall ensure that each employee can demonstrate knowledge of at least the following:
  - (i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
  - (ii) What the limitations and capabilities of the respirator are;

- (iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
  - (iv) How to inspect, put on and remove, use, and check the seals of the respirator;
  - (v) What the procedures are for maintenance and storage of the respirator;
  - (vi) How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
  - (vii) The general requirements of this section.
- (2) The training shall be conducted in a manner that is understandable to the employee.
- (3) The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.
- (4) An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in paragraph (j)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (j)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.
- (5) Retraining shall be administered annually, and when the following situations occur:
  - (i) Changes in the workplace or the type of respirator render previous training obsolete.
  - (ii) Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or
  - (iii) Any other situation arises in which retraining appears necessary to ensure safe respirator use.
- (6) The basic advisory information on respirators, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.
- (l) **Program evaluation.** This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

- (1) The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.
- (2) The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:
  - (i) Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
  - (ii) Appropriate respirator selection for the hazards to which the employee is exposed;
  - (iii) Proper respirator use under the workplace conditions the employee encounters; and
  - (iv) Proper respirator maintenance.
- (m) **Recordkeeping.** This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program and assist the employer in auditing the adequacy of the program.
  - (1) Medical evaluation. Records of medical evaluations required by this section must be retained.
  - (2) Fit testing.
    - (i) The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:
      - (A) The name or identification of the employee tested; Type of fit test performed; Specific make, model, style, and size of respirator tested; Date of test; and The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.
    - (ii) Fit test records shall be retained for respirator users until the next fit test is administered.
  - (3) A written copy of the current respirator program shall be retained by the employer.
  - (4) Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the authorized authority or designee for examination and copying.

## (n) Personal Protective Equipment used for Protection of the Respiratory

- (1) Personal protective equipment and clothing designed for the protection of the respiratory shall supply the user with breathable fresh air upon exposure to polluted air and/or insufficient oxygen concentration.
- (2) It is necessary that the breathable air supplied to the user by the personal protective equipment shall be through a proper mean, such as filtration of the polluted air through the equipment or through unpolluted external source.
- (3) Materials and components used for such types of personal protective equipment and clothing shall be chosen upon designing and manufacturing to ensure proper breathing for the user and fresh breathing device during the use.
- (4) Leakage of the pollutant shall be as low as possible, not to cause harm for the user in case of using the respiratory protection devices such as face masks and filtration devices in polluted air.
- (5) Personal protective equipment and clothing shall include details and characteristics of the equipment that help the user to be qualified and trained in the use of the equipment properly upon reading the instructions.

## (o) Types of Respiratory Protection

- (1) There are two main types of respiratory protection (NIOSH and EC)—air-purifying respirators (APRs) and atmosphere-supplying respirators (ASRs). Each respirator type provides a different level of protection based on its design. Therefore, it's important to choose the right type of respirator for the specific exposure.

Figure 4 Types of Respiratory Protection - NIOSH



- (2) NIOSH-Approved Particulate Filtering Respirators Classification: There are ten classes of NIOSH-approved particulate filtering respirators. These types of respirators use filters to remove particles from the air that is breathed through them. The N, R, and P designations refer to the filter's oil resistance as described in the table below.

*Table 5* Filter Class as per NIOSH

Filter Class	Description
N95, N99, N100	Filters at least 95%, 99%, 99.97% of airborne particles. Not resistant to oil.
R95, R99, R100	Filters at least 95%, 99%, 99.97% of airborne particles. Somewhat resistant to oil.
P95, P99, P100	Filters at least 95%, 99%, 99.97% of airborne particles. Strongly resistant to oil.
HE (High Efficiency Particulate Air)	Filters at least 99.97% of airborne particles. For use on PAPRs only. PAPRs use only HE filters.

- (3) The EN 149 standard defines performance requirements for three classes of half masks: FFP1, FFP2 and FFP3. The protection provided by an FFP2 (or FFP3) mask includes the protection provided by a mask of the lower-numbered classes. A mask conforming to the standard must have its class written on it, along with the name of the standard and its year of publication, as well as any applicable option codes, e.g. "EN 149:2001 FFP1 NR D". Some manufacturers use in addition the colour of the elastic band to identify the mask class, however, the EN 149 standard does not specify any such colour coding and different manufacturers have used different colour schemes.

*Table 6* Filter class as per EN 149

Class[6]	Filter penetration limit (at 95 L/min air flow)	Inward leakage	Typical elastic band
FFP1	Filters at least 80% of airborne particles	<22%	Yellow
FFP2	Filters at least 94% of airborne particles	<8%	Blue or White



FFP3	Filters at least 99% of airborne particles	<2%	Red
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## (p) Marking

- The United States and the European Union require specific standards for the design, manufacturing, testing, and product markings for Personal Protective Equipment (PPE). In the US, NIOSH (National Institute for Occupational Safety and Health) approved N95 respirators or filtering facepiece respirators (FFR) need to be marked with an approval number which can be verified on the NIOSH Certified Equipment List (CEL) or the NIOSH Trusted-Source page. NIOSH-approved FFRs will always have one the following designations: N95, N99, N100, R95, R99, R100, P95, P99, P100.

Figure 6 Example of Exterior Marking as per NIOSH

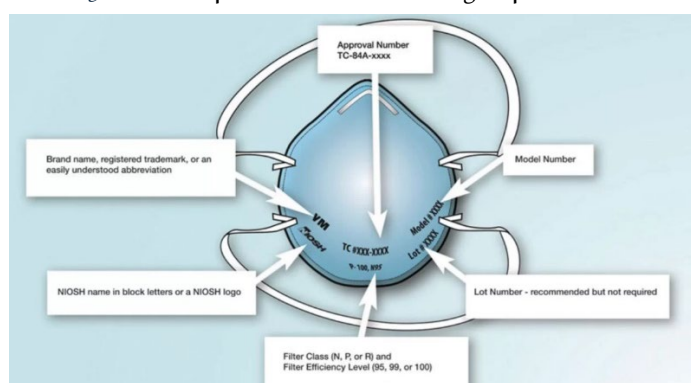
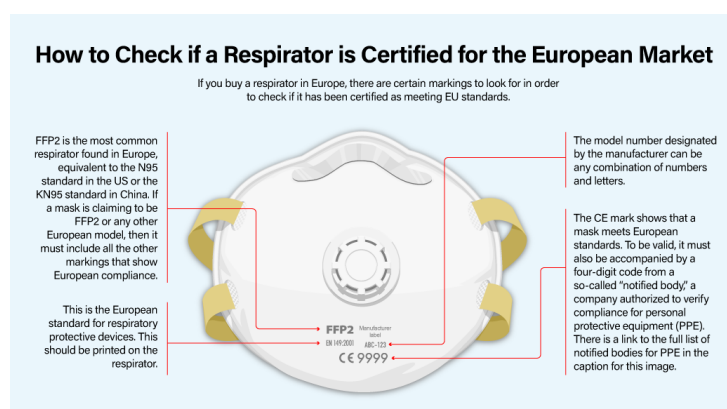


Figure 7 How to check Respirator Certification as per EN 149



## (q) Gas filters

- (1) Gas filters provide protection against vapours, chemical substances and toxic gases. They usually consist of a bed of activated carbon. They are described according to 2 criteria: filter type and class.
- (2) How are the various types of gas filter defined: A specific filter for a given gas or family of gases or vapours is indicated through marking consisting of a letter and a strip of a certain colour. If the filter is designed to protect against several families of gas simultaneously, we call it a combined filter: it is designated by the juxtaposition of a letter and the corresponding colour strips For example: AB = Filters organic gases/vapours and inorganic gases/vapours  
BK = Filters inorganic vapours, ammonia and ammonia derivatives
- (3) How to select the right class of efficiency for your gas filter: As for aerosol filters, there are three classes of protective filters based on their capacity (in other words, the best balance between volume and effectiveness of the absorbent material):
  - (i) Class 1: For gas concentrations of less than 0.1% by volume, the lowest capacity (filters for half masks) – e.g.: A1
  - (ii) Class 2: For gas concentrations of between 0.1% and 0.5% by volume, medium capacity (cartridge) – e.g. ABEK2
  - (iii) Class 3: For gas concentrations of between 0.5% and 1% by volume, the largest capacity (large-capacity canister worn at waist-level)
- (4) At an equivalent ambient concentration level, a class 3 filter will operate for longer than either a class 2 or a class 1 filter.

*Note: Some manufacturers offer specific filters that provide protection against carbon monoxide (CO). They are to be used exclusively with life-saving and evacuation devices.*

*Figure 8 Filter colour Code as per NIOSH and EC*

Colour code	Filter type	Filtered contaminant	Terms of use Filter capacity or efficiency
Dark brown	AX	Gases and vapours organic compounds with boiling point <65°C such as methyl acetate, acetone, butane, chloroform, methanol, freons...	Use immediately after opening For single use only Group 1: 100 ppm max 40 min, 500 ppm max 20 min Group 2: 1000 ppm max 60 min, 5000 ppm max 20 min
Light brown	A	Gases and vapours of organic compounds with boiling point <65°C mainly solvents and hydrocarbons such as acetates, acetic acids, acrylics, alcohols, benzene, phenols, styrene...	Class 1: 1000 ppm Class 2: 5000 ppm Class 3: 10000 ppm  With a ventilated system: Class 1: 500 ppm Class 2: 1000 ppm
Grey	B	Inorganic gases and vapours except CO: bromine, cyanide, chlorine, hydrogen sulphide, fluorine, isocyanates, formol, hydrocyanic acid, etc.	
Yellow	E	Acid gases and vapours: sulphuric anhydride, sulphur dioxide, hydrochloric acid, hydrofluoric acid, formic acid, etc.	
Green	K	Ammonia and organic ammonia derivatives: hydrazine, methylamine, aziridine...	
Black	CO	Carbon monoxide	Single use (max 10000 ppm)
Red	Hg	Mercury vapours	Maximum operating time: 50 hours
Blue	NO	Nitrous vapours and nitrogen oxides	Maximum use time: 20 minutes, single use
Orange	Reactor	Radioactive iodine, including radioactive methane iodide	Depending on the level of radioactivity
White	P	Particles	P1: filter efficiency > 80% P2: filter efficiency > 94% P3: filter efficiency > 99.95%

- (5) How long is a gas filter effective for: A gas filter no longer functions properly when the carbon granules become saturated. It starts to let through all the pollutants with which it is in contact. For this reason, a gas filter needs to be replaced on a regular basis, before the filter becomes totally saturated. It is important to know the minimum breakthrough time required by the NF EN 14387 and A1 standard:

Table 7 Filter Type and class by Minimum breakdown time

Filter Type and Class	TEST GAS	Test Gas Concentration (PPM)	Minimum Breakdown Time (Min)
A1	Cyclohexane	1000	70
	Chlore	1000	20
B1	Hydrogen sulfide	1000	40
	Hydrogen cyanide	1000	25
E1	Sulfur dioxide	1000	20
K1	Ammoniac	1000	50
A2	Cyclohexane	5000	35
	Chlore	5000	20
B2	Hydrogen sulfide	5000	40
	Hydrogen cyanide	5000	25
E2	Sulfur dioxide	5000	20
K2	Ammoniac	5000	40
A3	Cyclohexane	8000	65
	Chlore	10000	30

B3	Hydrogen sulfide	10000	60
	Hydrogen cyanide	10000	35
E3	Sulfur dioxide	10000	30
K3	Ammoniac	10000	60
AX	Dimethylether	500	50
	Isobutane	2500	50

## 10.51 Head Protection

### (a) General requirements.

- (1) The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects.
- (2) The employer shall ensure that a protective helmet designed to reduce electrical shock hazard is worn by each such affected employee when near exposed electrical conductors which could contact the head.

More details can be found in SASO Guide on occupational safety and health (safety helmet) – General Requirements, and in SASO-3001 Occupational safety and health procedures in the work environment - safety helmet, ANSI Z89.1 – Industrial Head Protection, and ISO 3873 for Industrial safety helmets.

### (b) Criteria for head protection.

- (1) Head protection must comply with the following consensus standards:
  - (i) SASO-3001 Occupational safety and health procedures in the work environment - safety helmet, SASO-Guide on occupational safety and health-safety helmet, or equivalent SASO standards.

Additional details can be found in American National Standards Institute (ANSI) Z89.1, "American National Standard for Industrial Head Protection, or in American National Standards Institute (ANSI) Z89.1, "American National Standard for Personnel Protection—Protective Headwear for Industrial Workers—Requirements,".



## 10.52 Foot Protection

### (a) General requirements:

- (1) The employer shall provide protective footwear according to the work nature and the risk without any required payment.
- (2) The employee shall ensure that there is continuous supervision on the workers to make sure they are wearing their protective footwear when working.
- (3) The employee shall provide training to the workers on how to choose and how to use the protective footwear
- (4) The employers shall wear the protective footwear when required
- (5) The employers shall shall maintain protective footwear integrity and store it appropriately.

More details can be found in SASO Guide on occupational safety and health – Safety Shoes – General Requirements, and in SASO-2992 Occupational safety and health procedures in the work environment - safety shoes, GSO ISO 20345 GSO ISO 20346 GSO ISO 20347 GSO ISO 20344.

### (b) Criteria for Protective Footwear


















































- (1) Protective footwear must comply with the following consensus standards:
  - (i) SASO-2992 Occupational safety and health procedures in the work environment - safety shoes, or equivalent
  - (ii) SASO Guide on occupational safety and health – Safety Shoes
  - (iii) ASTM F–2412–2005, “Standard Test Methods for Foot Protection,” and ASTM F–2413–2005, “Standard Specification for Performance Requirements for Protective Footwear,” Additional Information can be found in ANSI Z41–1999, “American National Standard for Personal Protection—Protective Footwear,”; or ANSI Z41–1991, “American National Standard for Personal Protection—Protective Footwear,”
- (2) Protective footwear that the employer demonstrates is at least as effective as protective footwear that is constructed in accordance with one of the above consensus standards will be deemed to be in compliance with the requirements of this section.

### (c) Types of shoes

There is a wide range of styles in professional footwear. Depending on the degree of protection, there are two main types:

- (1) Safety or protective footwear. It has a minimum impact resistance of 200 Joules and compressive strength of at least 15 kN at the toe cap, in addition to other characteristics such as being antistatic.































Figure 8-Safety footwear that does require a safety toecap

EN ISO 20345		BASIC TOE PROTECTION	SLIP RESISTANT	CLOSED HEEL	ANTISTATIC	OIL & FUEL RESISTANCE	HEEL ENERGY ABSORPTION	WATER REPELLENT UPPERS	PUNCTURE RESISTANCE	CLEATED OUTSOLE
CODE		B	SRA / SRB / SRC	/	A	FO	E	WRU	P	/
CLASS 1	SB									
	S1									
	S1P									
	S2									
	S3									
CLASS 2	SB									
	S4									
	S5									

- (2) Occupational footwear

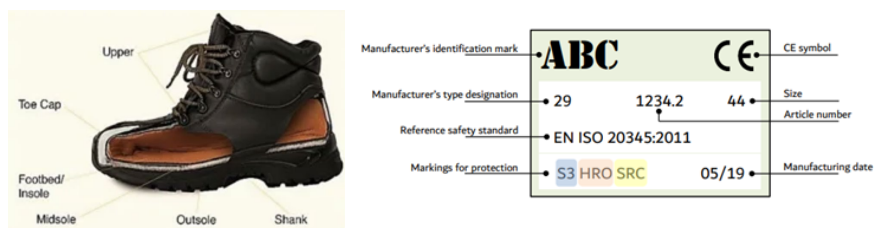
In this case, the toecap and insole are not impact-resistant, but both comply with anti-slip and water-repellent protection criteria.

Figure 9- occupational footwear

EN ISO 20347		SLIP RESISTANT	CLOSED HEEL	ANTISTATIC	HEEL ENERGY ABSORPTION	WATER REPELLENT UPPERS	PUNCTURE RESISTANCE	CLEATED OUTSOLE
CODE		SRA / SRB / SRC	/	A	E	WRU	P	/
CLASS 1	0B							
	01							
	02							
	03							
CLASS 2	0B							
	04							
	05							

- (d) Marking

Marking on shoes shall be in compliance with ISO20345/ISO20346/ISO20347



Class	Feature
SB	Safety basic, 200-Joule Toe Protection, Oil Resistant outer sole. (Minimum Requirement)
SBP	As SB plus Mid-Sole for penetration resistance.
S1	As SB plus Anti-Static properties and fully enclosed Energy Absorbing heel area.
S1P	As S1 plus Mid-Sole for penetration resistance.
S2	As S1 plus resistance to Water Penetration and absorption.
S3	As S2 plus Mid-Sole for penetration resistance and cleated outsole
S4	200-Joule Toe Protection. All rubber or polymer construction (waterproof). Anti-Static properties, Energy Absorbing heel area.
S5	As S4 plus Mid-Sole for penetration resistance and cleated outsole

## 10.53 Electrical Protective Equipment

(a) Design requirements for specific types of electrical protective equipment.

Rubber insulating blankets, rubber insulating matting, rubber insulating covers, rubber insulating line hose, rubber insulating gloves, and rubber insulating sleeves shall meet the following requirements:

- (1) The characteristics of protective equipment shall be determined with respect to their function, which may be, e.g., protection against the effects of:
  - (i) overcurrent (overload, short-circuit);
  - (ii) earth fault current;
  - (iii) overvoltage;



- (iv) undervoltage and no-voltage.

The protective devices shall operate at values of current, voltage and time, which are suitably related to the characteristics of the circuits and to the possibilities of danger. (SBC 401 Electrical: Chapter 12 ; 12-2.8 : Protective Equipment).

- (2) Manufacture and marking of rubber insulating equipment.

- (i) Blankets, gloves, and sleeves shall be produced by a seamless process.
- (ii) Each item shall be clearly marked as follows:

- (A) Class 00 equipment shall be marked Class 00.
- (B) Class 0 equipment shall be marked Class 0.
- (C) Class 1 equipment shall be marked Class 1.
- (D) Class 2 equipment shall be marked Class 2.
- (E) Class 3 equipment shall be marked Class 3.
- (F) Class 4 equipment shall be marked Class 4.
- (G) Nonozone-resistant equipment shall be marked Type I.
- (H) Ozone-resistant equipment shall be marked Type II.
- (I) Other relevant markings, such as the manufacturer's identification and the size of the equipment, may also be provided.

- (iii) Markings shall be nonconducting and shall be applied in such a manner as not to impair the insulating qualities of the equipment.

- (iv) Markings on gloves shall be confined to the cuff portion of the glove.

- (3) Electrical requirements.

- (i) Equipment shall be capable of withstanding the ac proof-test voltage specified in Table 8 or the dc proof-test voltage specified in Table 9.

- (A) The proof test shall reliably indicate that the equipment can withstand the voltage involved.
- (B) The test voltage shall be applied continuously for 3 minutes for equipment other than matting and shall be applied continuously for 1 minute for matting.
- (C) Gloves shall also be capable of separately withstanding the ac proof-test voltage specified in Table 8 after a 16-hour water soak.

- (ii) When the ac proof test is used on gloves, the 60-hertz proof-test current may not exceed the values specified in Table 8 at any time during the test period.
    - (A) If the ac proof test is made at a frequency other than 60 hertz, the permissible proof-test current shall be computed from the direct ratio of the frequencies.
    - (B) For the test, gloves (right side out) shall be filled with tap water and immersed in water to a depth that is in accordance with Table 10. Water shall be added to or removed from the glove, as necessary, so that the water level is the same inside and outside the glove.
    - (C) After the 16-hour water soak, the 60-hertz proof-test current may not exceed the values given in Table 8 by more than 2 milliamperes.
  - (iii) Equipment that has been subjected to a minimum breakdown voltage test may not be used for electrical protection.
  - (iv) Material used for Type II insulating equipment shall be capable of withstanding an ozone test, with no visible effects. The ozone test shall reliably indicate that the material will resist ozone exposure in actual use. Any visible signs of ozone deterioration of the material, such as checking, cracking, breaks, or pitting, is evidence of failure to meet the requirements for ozone-resistant material.
- (4) Workmanship and finish
- (i) Equipment shall be free of physical irregularities that can adversely affect the insulating properties of the equipment and that can be detected by the tests or inspections required under this section.
  - (ii) Surface irregularities that may be present on all rubber goods (because of imperfections on forms or molds or because of inherent difficulties in the manufacturing process) and that may appear as indentations, protuberances, or imbedded foreign material are acceptable under the following conditions:
    - (A) The indentation or protuberance blends into a smooth slope when the material is stretched.
    - (B) Foreign material remains in place when the insulating material is folded and stretches with the insulating material surrounding it.

More requirements for types of electrical protective equipment can be found in: ASTM D120—09, ASTM D178—01(2010), ASTM D1048—12, ASTM D1049—98(2010), ASTM D1050—05(2011), ASTM D1051—08, ASTM F1236—96 (2012), ASTM F819—10

(b) **Design requirements for other types of electrical protective equipment.** The following requirements apply to the design and manufacture of electrical protective equipment that is not covered by paragraph (a) of this section:

- (1) Voltage withstands: Insulating equipment used for the protection of employees shall be capable of withstanding, without failure, the voltages that may be imposed upon it.
- (2) Equipment current:
  - (i) Protective equipment used for the primary insulation of employees from energized circuit parts shall be capable of passing a current test when subjected to the highest nominal voltage on which the equipment is to be used.
  - (ii) When insulating equipment is tested in accordance with paragraph (b)(2)(i) of this section, the equipment current may not exceed 1 microampere per kilovolt of phase-to-phase applied voltage.

*Note 1 to paragraph (b)(2):*

*This paragraph applies to equipment that provides primary insulation of employees from energized parts. It does not apply to equipment used for secondary insulation or equipment used for brush contact only.*

*Note 2 to paragraph (b)(2):*

*For ac excitation, this current consists of three components: Capacitive current because of the dielectric properties of the insulating material itself; conduction current through the volume of the insulating equipment; and leakage current along the surface of the tool or equipment. The conduction current is normally negligible. For clean, dry insulating equipment, the leakage current is small, and the capacitive current predominates.*

*Note to paragraph (b):*

*Plastic guard equipment is deemed to conform to the performance requirements of paragraph (b) of this section if it meets, and is used in accordance with, ASTM F712—06 (2011), Standard Test Methods and Specifications for Electrically Insulating Plastic Guard Equipment for Protection of Workers.*

(c) **In-service care and use of electrical protective equipment —**

- (1) General. Electrical protective equipment shall be maintained in a safe, reliable condition.

- (2) Specific requirements. The following specific requirements apply to rubber insulating blankets, rubber insulating covers, rubber insulating line hose, rubber insulating gloves, and rubber insulating sleeves:
- (i) Maximum use voltages shall conform to those listed in Table 11.
  - (ii) Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of causing damage. Insulating gloves shall be given an air test, along with the inspection. More details can be found in ASTM F1236-96.
  - (iii) Insulating equipment with any of the following defects may not be used:
    - (A) A hole, tear, puncture, or cut;
    - (B) Ozone cutting or ozone checking (that is, a series of interlacing cracks produced by ozone on rubber under mechanical stress);
    - (C) An embedded foreign object;
    - (D) Any of the following texture changes: swelling, softening, hardening, or becoming sticky or inelastic.
    - (E) Any other defect that damages the insulating properties.
  - (iv) Insulating equipment found to have other defects that might affect its insulating properties shall be removed from service and returned for testing under paragraphs (c)(2)(viii) and (c)(2)(ix) of this section.
  - (v) Insulating equipment shall be cleaned as needed to remove foreign substances.
  - (vi) Insulating equipment shall be stored in such a location and in such a manner as to protect it from light, temperature extremes, excessive humidity, ozone, and other damaging substances and conditions.
  - (vii) Protector gloves shall be worn over insulating gloves, except as follows:
    - (A) Protector gloves need not be used with Class 0 gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity.
    - (B) If the voltage does not exceed 250 volts, ac, or 375 volts, dc, protector gloves need not be used with Class 00 gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity.

- (C) Any other class of glove may be used without protector gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity but only if the employer can demonstrate that the possibility of physical damage to the gloves is small and if the class of glove is one class higher than that required for the voltage involved.
- (D) Insulating gloves that have been used without protector gloves may not be reused until they have been tested under the provisions of paragraphs (c)(2)(viii) and (c)(2)(ix) of this section.

(viii) Electrical protective equipment shall be subjected to periodic electrical tests. Test voltages and the maximum intervals between tests shall be in accordance with Table 11 and Table 12.

- (ix) The test method used under paragraphs (c)(2)(viii) and (c)(2)(xi) of this section shall reliably indicate whether the insulating equipment can withstand the voltages involved.

Details on test methods can be found in: ASTM D120–09, ASTM D178–01 (2010), ASTM D1048–12, ASTM D1049–98 (2010), ASTM D1050–05 (2011), ASTM D1051–08, ASTM F478–09, ASTM F479–06 (2011), ASTM F496–08.

- (x) Insulating equipment failing to pass inspections or electrical tests may not be used by employees, except as follows:

- (A) Rubber insulating line hose may be used in shorter lengths with the defective portion cut off.
- (B) Rubber insulating blankets may be salvaged by severing the defective area from the undamaged portion of the blanket. The resulting undamaged area may not be smaller than 560 millimeters by 560 millimeters (22 inches by 22 inches) for Class 1, 2, 3, and 4 blankets.
- (C) Rubber insulating blankets may be repaired using a compatible patch that results in physical and electrical properties equal to those of the blanket.
- (D) Rubber insulating gloves and sleeves with minor physical defects, such as small cuts, tears, or punctures, may be repaired by the application of a compatible patch. Also, rubber insulating gloves and sleeves with minor surface blemishes may be repaired with a compatible liquid compound. The repaired area shall have electrical and

physical properties equal to those of the surrounding material. Repairs to gloves are permitted only in the area between the wrist and the reinforced edge of the opening.

- (xi) Repaired insulating equipment shall be retested before it may be used by employees.
- (xii) The employer shall certify that equipment has been tested in accordance with the requirements of paragraphs (c)(2)(iv), (c)(2)(vii)(D), (c)(2)(viii), (c)(2)(ix), and (c)(2)(xi) of this section. The certification shall identify the equipment that passed the test and the date it was tested.

Table 8—AC Proof-Test Requirements

Class Of Equipment	Proof-test Voltage rms V	Maximum proof-test current, mA (gloves only)			
		280-mm (11-in) glove	360-mm (14-in) glove	410-mm (16-in) glove	460-mm (18-in) glove
00	2,500	8	12		
0	5,000	8	12	14	16
1	10,000		14	16	18
2	20,000		16	18	20
3	30,000		18	20	22
4	40,000			22	24

Table 9—DC Proof-Test Requirements

Class of equipment	Proof—test voltage
00	10,000
0	20,000
1	40,000
2	50,000
3	60,000

**Note:** The dc voltages listed in this table are not appropriate for proof testing rubber insulating line hose or covers. For this equipment, dc proof tests shall use a voltage high enough to indicate that the equipment can be safely used at the voltages listed in Table 11. See ASTM D1050–05 (2011) and ASTM D1049–98 (2010) for further information on proof tests for rubber insulating line hose and covers, respectively.

Table 10—Glove Tests—Water Level<sup>12</sup>

Class of glove	AC proof test		DC proof test	
	mm	in	mm	in
00	38	1.5	38	1.5
0	38	1.5	38	1.5

1	38	1.5	51	2.0
2	64	2.5	76	3.0
3	89	3.5	102	4.0
4	127	5.0	153	6.0

<sup>1</sup>The water level is given as the clearance from the reinforced edge of the glove to the water line, with a tolerance of  $\pm 13$  mm. ( $\pm 0.5$  in.).

<sup>2</sup> If atmospheric conditions make the specified clearances impractical, the clearances may be increased by a maximum of 25 mm. (1 in.).

Table 11—Rubber Insulating Equipment, Voltage Requirements

Class of equipment	Maximum use voltage <sup>1</sup> AC rms	Retest voltage <sup>2</sup> AC rms	Retest voltage <sup>2</sup> DC avg
00	500	2,500	10,000
0	1,000	5,000	20,000
1	7,500	10,000	40,000
2	17,000	20,000	50,000
3	26,500	30,000	60,000
4	36,000	40,000	70,000

<sup>1</sup>The maximum use voltage is the ac voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage if:

- (1) There is no multiphase exposure in a system area and the voltage exposure is limited to the phase-to-ground potential, or
- (2) The electric equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.

<sup>2</sup>The proof-test voltage shall be applied continuously for at least 1 minute, but no more than 3 minutes.

Table 12—Rubber Insulating Equipment, Test Intervals

Type of equipment	When to test
Rubber insulating line hose	Up on indication that insulating value is suspect and after repair.
Rubber insulating covers	Upon indication that insulating value is suspect and after repair.
Rubber insulating blankets	Before first issue and every 12 months thereafter; <sup>1</sup> upon indication that insulating value is suspect; and after repair.
Rubber insulating gloves	Before first issue and every 6 months thereafter; <sup>1</sup> upon indication that insulating value is suspect; after repair; and after use without protectors.
Rubber insulating sleeves	Before first issue and every 12 months thereafter; <sup>1</sup> upon indication that insulating value is suspect; and after repair.

<sup>1</sup>If the insulating equipment has been electrically tested but not issued for service, the insulating equipment may not be placed into service unless it has been electrically tested within the previous 12 months.

## 10.54 Hand Protection

### (a) General requirements.

- (1) Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.
- (2) The employer shall provide the appropriate hand protection according to the work nature and the risk without any required payment.
- (3) The employer shall ensure that there is continuous supervision on the workers to make sure they are wearing their hand protection when working.
- (4) The employer shall provide training to the workers on how to choose and how to use the hand protection.
- (5) The employers shall wear hand protection when required.

More details can be found in SASO Guide on occupational safety and health – Hand Protection – General Requirements, and in SASO-3000 Occupational safety and health procedures in the work environment - protect hands.

**(b) Selection.** Employers shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified.

### (c) Mechanical Protection:

Levels of protective glove performance against mechanical hazards are described in the American standard ANSI/ISEA 105. Cut resistance is based on the version of the ASTM F 1790 standard adopted in 1997. It corresponds to the force deployed over a cut-through distance of 25 mm. Puncture resistance must be measured according to the version of the EN 388 standard . It corresponds to the maximum force established using a probe with a conical head of 4.5 mm diameter. For these two properties, and as illustrated in the table below, there are six levels. The higher the level, the greater the resistance of the material will be.



## (1) Classification proposed by the American standard.

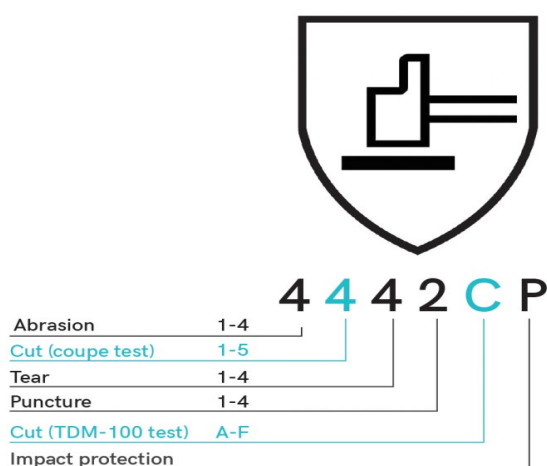
Table 13-Classification proposed by the American standard

	Performance levels (ANSI/ISEA 105-2005)						
	0	1	2	3	4	5	6
Cut resistance (g)	< 200	≥ 200	≥ 500	≥ 1000	≥ 1500	≥ 3500	
Puncture resistance (N)	< 10	≥ 10	≥ 20	≥ 60	≥ 100	≥ 150	
Abrasion resistance (cycles)	< 100 <sup>#</sup>	≥ 100 <sup>#</sup>	≥ 500 <sup>#</sup>	≥ 1000 <sup>#</sup>	≥ 3000 <sup>‡</sup>	≥ 10000 <sup>‡</sup>	≥ 20000 <sup>‡</sup>

<sup>#</sup> Abrasive wheels corresponding to a force of 500 g<sup>‡</sup> Abrasive wheels corresponding to a force of 1000 g

## (2) Performance Criteria as per the European standards

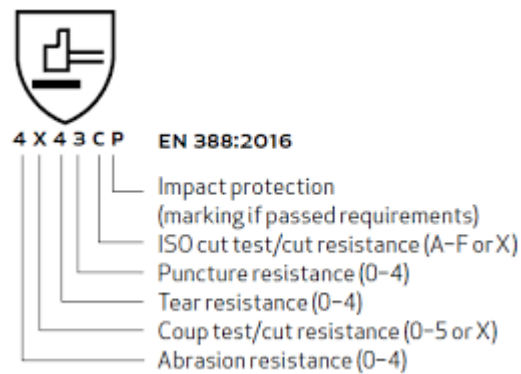
The European standard for protective gloves uses the performance criteria described in the European standard, EN 388.



## (3) Classification of the European standards

Table 14-Classification proposed by the European standards

	Abrasion Resistance (Cycles)	Cut Resistance (Factor)	Tear Resistance (Newtons)	Puncture Resistance (Newtons)	Straight Blade Cut Resistance (Newtons)	Impact Resistance (≤ 7kN)
0 (A)	<100	<1.2	<10	<20	≥2	X: No test
1 (B)	100	1.2	10	20	≥5	
2 (C)	500	2.5	25	60	≥10	F: Fail
3 (D)	2000	5.0	50	100	≥15	
4 (E)	8000	10.0	75	150	≥22	P: Pass
5 (F)		20.0			≥30	



(d) Electrical Protection:



2/5 Electrical Protection: Insulation provided by gloves when in direct contact with live electrical components, classified as follows: Voltage Ratings:

- (1) 1/2/5 Volts: 500 AC - 750 DC
- (2) 2/2/5 Volts: 1000 AC - 1500 DC
- (3) 3/2/5 Volts: 7500 AC - 11250 DC
- (4) 4/2/5 Volts: 17000 AC - 25500 DC
- (5) 5/2/5 Volts: 26500 AC - 39500 DC
- (6) 6/2/5 Volts: 36000 AC - 54000 DC

(e) Chemical Protection

- (1) Categorization of chemical-resistant gloves: Chemical resistant gloves are categorized into three classes, Type A, Type B, Type C as shown in the table below.

Table 15-1 pictogram & 3 types of glove

Glove's Type	Requirement	Marking
<b>Type A</b>	<ul style="list-style-type: none"> <li>× <b>Penetration resistance</b> (EN 374-2)</li> <li>× Breakthrough time <b>≥ 30 min</b> against at least <b>6 chemicals</b> of the new list (EN 16523-1)</li> </ul>	EN ISO 374-1/ Type A  A J K L P R
<b>Type B</b>	<ul style="list-style-type: none"> <li>× <b>Penetration resistance</b> (EN 374-2)</li> <li>× Breakthrough time <b>≥ 30 min</b> against at least <b>3 chemicals</b> of the new list (EN 16523-1)</li> </ul>	EN ISO 374-1 / Type B  J K L
<b>Type C</b>	<ul style="list-style-type: none"> <li>× <b>Penetration resistance</b> (EN 374-2)</li> <li>× Breakthrough time <b>≥ 10 min</b> against at least <b>1 chemical</b> of the new list (EN 16523-1)</li> </ul>	EN ISO 374-1 / Type C 

The third row in the Type A and B symbols shows the chemicals which the material has been protected against, they can be found in the table below. Chemical resistant gloves use instruction sheets which should provide information about penetration, as chemicals can penetrate through holes in the material, and degradation, which is expressed as a percentage (%). In addition to this, chemical resistant gloves may provide information about whether they protect against bacteria, fungi and viruses. In this instance, the biohazard symbol is shown on the glove with the specific micro-organism it protects against listed alongside.

Code letter	Chemical	CAS Number	Class
A	Methanol	67-56-1	Primary alcohol
B	Acetone	67-64-1	Ketone
C	Acetonitrile	75-05-8	Nitrile compound
D	Dichloromethane	75-09-2	Chlorinated hydrocarbon
E	Carbon disulphide	75-15-0	Sulphur containing organic compound
F	Toluene	108-88-3	Aromatic hydrocarbon
G	Diethylamine	109-89-7	Amine
H	Tetrahydrofuran	109-99-9	Heterocyclic and ether compound
I	Ethyl acetate	141-78-6	Ester
J	n-Heptane	142-82-5	Saturated hydrocarbon
K	Sodium hydroxide 40%	1310-73-2	Inorganic base
L	Sulphuric acid 96%	7664-93-9	Inorganic mineral acid, oxidising
M	Nitric acid 65%	7697-37-2	Inorganic mineral acid, oxidising
N	Acetic acid 99%	64-19-7	Organic acid
O	Ammonium hydroxide 25%	1336-21-6	Organic base
P	Hydrogen peroxide 30%	7722-84-1	Peroxide
S	Hydrofluoric acid 40%	7664-39-3	Inorganic mineral acid
T	Formaldehyde 37%	50-00-0	Aldehyde

## (2) Glove Material


The UK HSE guide on protective gloves recommends the following suitable materials for different chemical groups (water soluble substances, organic solvents, strong acids, etc).


Chemical group	Glove Material					
	Natural rubber	Nitrile rubber	Neoprene™	PVC	Butyl	Viton™

Water miscible substances, weak acids/alkalis	✓	✓	✓	✓		
Oils		✓				
Chlorinated hydrocarbons						✓
Aromatic Solvents						✓
Aliphatic solvents		✓				✓
Strong acids					✓	
Strong alkalis			✓			
PCBs						✓

## (f) Heat and Flame Protection:

- (1) 1/4/5 Thermal Insulation Resistance: Resistance to heat transfer and duration of heat exposure if direct flame removal occurs.
- (2) 2/4/5 Flame Damage Resistance: Resistance to damage resulting from exposure to flames (thermal ignition resistance).
- (3) 3/4/5 Conductive Heat Resistance: Protection from heat when touching a hot surface.
- (4) 5/5 Heat Reduction: Resistance to heat transfer across a spectrum of frequencies.
- (5) 6/5 Heat Resistance Grade:

EN 407		Performance Level	1	2	3	4
 a b c d e f	a. Burning Behaviour	After flame time	< 20 s	< 10 s	< 3 s	< 2 s
		After flame glow	not required	< 120 s	< 25 s	< 5 s
	b. Contact Heat	Contact temperature	100°C	250°C	350°C	500°C
		Threshold time	> 15 s	> 15 s	> 15 s	> 15 s
	c. Convective Heat (heat transfer delay)		> 4 s	> 7 s	> 10 s	> 18 s
	d. Radiant Heat (heat transfer delay)		> 7 s	> 20 s	> 50 s	> 95 s
	e. Small Drops Molten Metal (# drops)		> 10	> 15	> 25	> 35
	f. Large Quantity Molten Metal (mass)		30g	60g	120g	200g

		<div style="text-align: center;"> <b>EN 407</b>   </div>					
	Rating	4	3	4	2	4	3
Flammability	1-4	←					
Contact heat	1-4	←					
Connective heat	1-4	←					
Radiant heat	1-4	←					
Small drops of molten metal	1-4	←					
Large drops of molten metal	1-4	←					

(g) Radiant Heat Insulation:

- (1) 1/6/5 Radiant Heat Radiation Insulation: Resistance to transmission of radiant heat (radiant heat insulation).
- (2) 2/6/5 Radiant and Portable Heat Insulation: Resistance to transmission of radiant and portable heat (heat insulation).
- (3) 3/6/5 Portable Cold Insulation: Protection for the wearer from cold temperatures in the environment.
- (4) 4/6/5 Conductive Cold Resistance: Protection for the wearer when touching a cold surface.

More details can be found in SASO Guide on occupational safety and health – Hand Protection , and in SASO-3000 Occupational safety and health procedures in the work environment - protect hands.

## 10.55 Personal fall Protection Systems

- (a) Scope and application: This section establishes performance, care, and use criteria for all personal fall protection systems. The employer must ensure that each personal fall protection system used to comply with this part must meet the requirements of this section.
- (b) Definitions.
  - (1) **Anchorage** means a secure point of attachment for equipment such as lifelines, lanyards, or deceleration devices.
  - (2) **Belt terminal** means an end attachment of a window cleaner's positioning system used for securing the belt or harness to a window cleaner's belt anchor.

- (3) **Body belt** means a strap with means both for securing about the waist and for attaching to other components such as a lanyard used with positioning systems, travel restraint systems, or ladder safety systems.
- (4) **Body harness** means straps that secure about the employee in a manner to distribute the fall arrest forces over at least the thighs, pelvis, waist, chest, and shoulders, with a means for attaching the harness to other components of a personal fall protection system.
- (5) **Carabiner** means a connector generally comprised of a trapezoidal or oval shaped body with a closed gate or similar arrangement that may be opened to attach another object and, when released, automatically closes to retain the object.
- (6) **Competent person** means a person who is capable of identifying existing and predictable hazards in any personal fall protection system or any component of it, as well as in their application and uses with related equipment, and who has authorization to take prompt, corrective action to eliminate the identified hazards.
- (7) **Connector** means a device used to couple (connect) parts of the fall protection system together.
- (8) **D-ring** means a connector used:
  - (9) (i) In a harness as an integral attachment element or fall arrest attachment;
  - (10) (ii) In a lanyard, energy absorber, lifeline, or anchorage connector as an integral connector; or
  - (11) (iii) In a positioning or travel restraint system as an attachment element.
- (12) **Deceleration device** means any mechanism that serves to dissipate energy during a fall.
- (13) **Deceleration distance** means the vertical distance a falling employee travels from the point at which the deceleration device begins to operate, excluding lifeline elongation and free fall distance, until stopping. It is measured as the distance between the location of an employee's body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.
- (14) **Equivalent** means alternative designs, equipment, materials, or methods that the employer can demonstrate will provide an equal or greater degree of safety for employees compared to the designs, equipment, materials, or methods specified in the standard.
- (15) **Free fall** means the act of falling before the personal fall arrest system begins to apply force to arrest the fall.

- (16) **Free fall distance** means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, lifeline and lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before the devices operate and fall arrest forces occur.
- (17) **Lanyard** means a flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.
- (18) **Lifeline** means a component of a personal fall protection system consisting of a flexible line for connection to an anchorage at one end so as to hang vertically (vertical lifeline), or for connection to anchorages at both ends so as to stretch horizontally (horizontal lifeline), and serves as a means for connecting other components of the system to the anchorage.
- (19) **Personal fall arrest system** means a system used to arrest an employee in a fall from a walking-working surface. It consists of a body harness, anchorage, and connector. The means of connection may include a lanyard, deceleration device, lifeline, or a suitable combination of these.
- (20) **Personal fall protection system** means a system (including all components) an employer uses to provide protection from falling or to safely arrest an employee's fall if one occurs. Examples of personal fall protection systems include personal fall arrest systems, positioning systems, and travel restraint systems.
- (21) **Positioning system (work-positioning system)** means a system of equipment and connectors that, when used with a body harness or body belt, allows an employee to be supported on an elevated vertical surface, such as a wall or window sill, and work with both hands free. Positioning systems also are called "positioning system devices" and "work-positioning equipment."
- (22) **Qualified** describes a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.
- (23) **Rope grab** means a deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/lever locking, or both.

- (24) **Safety factor** means the ratio of the design load and the ultimate strength of the material.
  - (25) **Self-retracting lifeline/lanyard** means a deceleration device containing a drum-wound line that can be slowly extracted from, or retracted onto, the drum under slight tension during normal movement by the employee. At the onset of a fall, the device automatically locks the drum and arrests the fall.
  - (26) **Snaphook** means a connector comprised of a hook-shaped body with a normally closed gate, or similar arrangement that may be manually opened to permit the hook to receive an object. When released, the snaphook automatically closes to retain the object. Opening a snaphook requires two separate actions. Snaphooks are generally one of two types:
    - (27) Automatic-locking type (permitted) with a self-closing and self-locking gate that remains closed and locked until intentionally unlocked and opened for connection or disconnection; and
    - (28) Non-locking type (prohibited) with a self-closing gate that remains closed, but not locked, until intentionally opened for connection or disconnection.
  - (29) **Travel restraint (tether) line** means a rope or wire rope used to transfer forces from a body support to an anchorage or anchorage connector in a travel restraint system.
  - (30) **Travel restraint system** means a combination of an anchorage, anchorage connector, lanyard (or other means of connection), and body support that an employer uses to eliminate the possibility of an employee going over the edge of a walking-working surface.
  - (31) **Window cleaner's belt** means a positioning belt that consists of a waist belt, an integral terminal runner or strap, and belt terminals.
  - (32) **Window cleaner's belt anchor (window anchor)** means specifically designed fall-preventing attachment points permanently affixed to a window frame or to a building part immediately adjacent to the window frame, for direct attachment of the terminal portion of a window cleaner's belt.
  - (33) **Window cleaner's positioning system** means a system which consists of a window cleaner's belt secured to window anchors.
- (c) General requirements: The employer must ensure that personal fall protection systems meet the following requirements. Additional requirements for personal fall arrest systems and positioning systems are contained in paragraphs (d) and (e) of this section, respectively.
- (1) Connectors must be drop forged, pressed or formed steel, or made of equivalent materials.



- (2) Connectors must have a corrosion-resistant finish, and all surfaces and edges must be smooth to prevent damage to interfacing parts of the system.
- (3) When vertical lifelines are used, each employee must be attached to a separate lifeline.
- (4) Lanyards and vertical lifelines must have a minimum breaking strength of 22.2 kN (5,000 pounds).
- (5) Self-retracting lifelines and lanyards that automatically limit free fall distance to 0.61 m (2 feet) or less must have components capable of sustaining a minimum tensile load of 13.3 kN (3,000 pounds) applied to the device with the lifeline or lanyard in the fully extended position.
- (6) A competent person or qualified person must inspect each knot in a lanyard or vertical lifeline to ensure that it meets the requirements of paragraphs (c)(4) and (5) of this section before any employee uses the lanyard or lifeline.
- (7) D-rings, snap hooks, and carabiners must be capable of sustaining a minimum tensile load of 22.2 kN (5,000 pounds).
- (8) D-rings, snap hooks, and carabiners must be proof tested to a minimum tensile load of 16 kN (3,600 pounds) without cracking, breaking, or incurring permanent deformation. The gate strength of snap hooks and carabiners must be capable of withstanding a minimum load of 16 kN (3,600 pounds) without the gate separating from the nose of the snap hook or carabiner body by more than 3.175 mm (0.125 inches).
- (9) Snap hooks and carabiners must be the automatic locking type that require at least two separate, consecutive movements to open.
- (10) Snap hooks and carabiners must not be connected to any of the following unless they are designed for such connections:
  - (i) Directly to webbing, rope, or wire rope;
  - (ii) To each other;
  - (iii) To a D-ring to which another snap hook, carabiner, or connector is attached;
  - (iv) To a horizontal life line; or
  - (v) To any object that is incompatibly shaped or dimensioned in relation to the snap hook or carabiner such that unintentional disengagement could occur when the connected object depresses the snap hook or carabiner gate, allowing the components to separate.
- (11) The employer must ensure that each horizontal lifeline:

- (i) Is designed, installed, and used under the supervision of a qualified person; and
  - (ii) Is part of a complete personal fall arrest system that maintains a safety factor of at least two.
- (12) Anchorages used to attach to personal fall protection equipment must be independent of any anchorage used to suspend employees or platforms on which employees work. Anchorages used to attach to personal fall protection equipment on mobile work platforms on powered industrial trucks must be attached to an overhead member of the platform, at a point located above and near the center of the platform.
- (13) Anchorages, except window cleaners' belt anchors covered by paragraph (e) of this section, must be:
  - (i) Capable of supporting at least 22.2 kN (5,000 pounds) for each employee attached; or
  - (ii) Designed, installed, and used, under the supervision of qualified person, as part of a complete personal fall protection system that maintains a safety factor of at least two.
- (14) Travel restraint lines must be capable of sustaining a tensile load of at least 22.2 kN (5,000 pounds).
- (15) Lifelines must not be made of natural fiber rope. Polypropylene rope must contain an ultraviolet (UV) light inhibitor.
- (16) Personal fall protection systems and their components must be used exclusively for employee fall protection and not for any other purpose, such as hoisting equipment or materials.
- (17) A personal fall protection system or its components subjected to impact loading must be removed from service immediately and not used again until a competent person inspects the system or components and determines that it is not damaged and safe for use for employee personal fall protection.
- (18) Personal fall protection systems must be inspected before initial use during each workshift for mildew, wear, damage, and other deterioration, and defective components must be removed from service.
- (19) Ropes, belts, lanyards, and harnesses used for personal fall protection must be compatible with all connectors used.
- (20) Ropes, belts, lanyards, lifelines, and harnesses used for personal fall protection must be protected from being cut, abraded, melted, or otherwise damaged.

- (21) The employer must provide for prompt rescue of each employee in the event of a fall.
- (22) Personal fall protection systems must be worn with the attachment point of the body harness located in the center of the employee's back near shoulder level. The attachment point may be located in the pre-sternal position if the free fall distance is limited to 0.6 m (2 feet) or less.

(d) Personal fall arrest systems

- (1) System performance criteria. In addition to the general requirements in paragraph (c) of this section, the employer must ensure that personal fall arrest systems:
  - (i) Limit the maximum arresting force on the employee to 8 kN (1,800 pounds);
  - (ii) Bring the employee to a complete stop and limit the maximum deceleration distance the employee travels to 1.1 m (3.5 feet);
  - (iii) Have sufficient strength to withstand twice the potential impact energy of the employee free falling a distance of 1.8 m (6 feet), or the free fall distance permitted by the system; and
  - (iv) Sustain the employee within the system/strap configuration without making contact with the employee's neck and chin area.
- (2) System use criteria: The employer must ensure that:
  - (i) On any horizontal lifeline that may become a vertical lifeline, the device used to connect to the horizontal lifeline is capable of locking in both directions on the lifeline.
  - (ii) Personal fall arrest systems are rigged in such a manner that the employee cannot free fall more than 1.8 m (6 feet) or contact a lower level. A free fall may be more than 1.8 m (6 feet) provided the employer can demonstrate the manufacturer designed the system to allow a free fall of more than 6 feet and tested the system to ensure a maximum arresting force of 8 kN (1,800 pounds) is not exceeded.
- (3) Body belts: Body belts are prohibited as part of a personal fall arrest system.

(e) Positioning systems:

- (1) System performance requirements: The employer must ensure that each positioning system meets the following requirements:

- (i) General: All positioning systems, except window cleaners' positioning systems, are capable of withstanding, without failure, a drop test consisting of a 1.2-m (4-foot) drop of a 113-kg (250-pound) weight.
- (ii) Window cleaners' positioning systems: All window cleaners' positioning systems must:
  - (A) Be capable of withstanding without failure a drop test consisting of a 1.8-m (6-foot) drop of a 113-kg (250-pound) weight; and
  - (B) Limit the initial arresting force on the falling employee to not more than 8.9 kN (2,000 pounds), with a duration not exceeding 2 milliseconds and any subsequent arresting forces to not more than 4.5 kN (1,000 pounds).
- (iii) Lineman's body belt and pole strap systems. Lineman's body belt and pole strap systems must meet the following tests:
  - (A) A dielectric test of 819.7 volts, AC, per centimeter (25,000 volts per foot) for 3 minutes without visible deterioration;
  - (B) A leakage test of 98.4 volts, AC, per centimeter (3,000 volts per foot) with a leakage current of no more than 1 mA; and
  - (C) A flammability test in accordance with Table I–7 of this section.

Table 16— Flammability Test

Test Method	Criteria for Passing Test
Vertically suspend a 500-mm (19.7-inch) length of strapping supporting a 100 kg (220.5-lb) weight;  Use a butane or propane burner with 76-mm (3-inch) flame;  Direct the flame to an edge of the strapping at a distance of 25mm (1inch);  Remove the falme after 5 seconds; and  Wait for any flames on the positioning strap to stop burning.	Any flames on the positioning strap must self-extinguish.          The positioning strap must continue to support the 100-kg (220.5-lb) mass.

- (2) System use criteria for window cleaners' positioning systems. The employer must ensure that window cleaners' positioning systems meet and are used in accordance with the following:
- (i) Window cleaners' belts are designed and constructed so that:
    - (A) Belt terminals will not pass through their fastenings on the belt or harness if a terminal comes loose from the window anchor; and
    - (B) The length of the runner from terminal tip to terminal tip is 2.44 m (8 feet) or less;
  - (ii) Window anchors to which belts are fastened are installed in the side frames or mullions of the window at a point not less than 106.7 cm (42 inches) and not more than 129.5 cm (51 inches) above the window sill;
  - (iii) Each window anchor is capable of supporting a minimum load of 26.5 kN (6,000 pounds);
  - (iv) Use of installed window anchors for any purpose other than attaching the window cleaner's belt is prohibited;
  - (v) A window anchor that has damaged or deteriorated fastenings or supports is removed, or the window anchor head is detached so the anchor cannot be used;
  - (vi) Rope that has wear or deterioration that affects its strength is not used;
  - (vii) Both terminals of the window cleaner's belt are attached to separate window anchors during any cleaning operation;
  - (viii) No employee works on a window sill or ledge on which there is snow, ice, or any other slippery condition, or one that is weakened or rotted;
  - (ix) No employee works on a window sill or ledge unless:
    - (A) The window sill or ledge is a minimum of 10 cm (4 inches) wide and slopes no more than 15 degrees below horizontal; or
    - (B) The 10-cm minimum width of the window sill or ledge is increased 1 cm (0.4 inches) for every degree the sill or ledge slopes beyond 15 degrees, up to a maximum of 30 degrees;
  - (x) The employee attaches at least one belt terminal to a window anchor before climbing through the window opening, and keeps at least one terminal attached until completely back inside the window opening;

- (xi) Except as provided in paragraph (d)(2)(xii) of this section, the employee travels from one window to another by returning inside the window opening and repeating the belt terminal attachment procedure at each window in accordance with paragraph (d)(2)(x) of this section;
- (xii) An employee using a window cleaner's positioning system may travel from one window to another while outside of the building, provided:
  - (A) At least one belt terminal is attached to a window anchor at all times;
  - (B) The distance between window anchors does not exceed 1.2 m (4 feet) horizontally.  
The distance between windows may be increased up to 1.8 m (6 feet) horizontally if the windowsill or ledge is at least 0.31 m (1 foot) wide and the slope is less than 5 degrees;
  - (C) The sill or ledge between windows is continuous; and
  - (D) The width of the windowsill or ledge in front of the mullions is at least 15.2 cm (6 inches) wide.